NHTSA-2000-8011-21

SUMMARY OF R&D SPONSORED TIRE DEBEADING TESTS

NHTSA Research and Development used two test procedures to evaluate the propensity of tires to debead. One is a modification of a procedure developed by Toyota that utilizes a sliding wedge-based test fixture (see Appendix 1 for description, drawings, and photos) and the second is a modified version of the FMVSS No. 109 test procedure. In the modified Toyota test procedure, the wedge is used to apply a force across the tread until the tire debeads or the rim comes in contact with the wedge. The FMVSS No. 109 test procedure was also modified to allow the plunger load to continue until bead unseating occurred.

Testing was carried out at an inflation pressure of 26 psi (180 kPa), as required by the current FMVSS, except as noted in the test matrix.

The Test Matrix and Summary Sheets of the results from this testing are provided in Appendix 2.

The Test Matrix table contains a row for each wedge debead test that includes the following: Size of the tire tested (Size), Brand, Construction, Test #, Tire Serial Number (SN), UTQG Rating, Load Index (LI), Speed Rating or Index (SI), Rim size (in inches)(Rim), Inflation pressure (if other than 26 psi) (PSI), Lube study (Lube 4 hrs, 24 hrs, 48 hrs, 1 week), whether an FMVSS No. 109 Bead Unseating (109 BU) test was completed on this tire, and Notes. For each row a minimum of 1 test was done. If multiple rim sizes are listed then a test was completed for each rim size listed. The lube study consisted of looking at the affect that time since mounting the tire with lube would have on the bead unseating force. For example if an "X" appears in the table for "24 hrs" then an additional debead test was completed 24 hours after the tire had been mounted to the rim using a common water-based tire mounting lubricant. All other testing was completed with tires that had been dry mounted – as is required by the current FMVSS No. 109 Regulation. Finally if an "X" appears in the column labeled "109 BU" then a tire was evaluated using the FMVSS No. 109 Bead Unseating test so that a comparison between the wedge-based test could be done.

1

The Summary Sheets contain: Tire Size, Brand, Test #, Rim size (inches)(Rim), the lateral force in lbs. required to unseat the tire using the wedge-based procedure (Wedge BU), a ratio of the force required to unseat the tire divided by the maximum load as listed on the tire's sidewall (WBU/max Load), the maximum inflation pressure from the tire's sidewall and the maximum load as listed on the tire's sidewall (PSI/Load), the lateral load in lbs. required to unseat the tire using the modified FMVSS No. 109 bead unseat procedure (109 BU), and comments. Appendix 2 also includes information pertaining to a small tire mounting lube study.

The primary finding from this testing is that the forces required to debead tires with the wedge-based procedure correlate very well with the forces needed to debead tires using the modified FMVSS No. 109 equipment. The correlation coefficient of this relationship is 0.879. This comparison is presented in Figure 1.
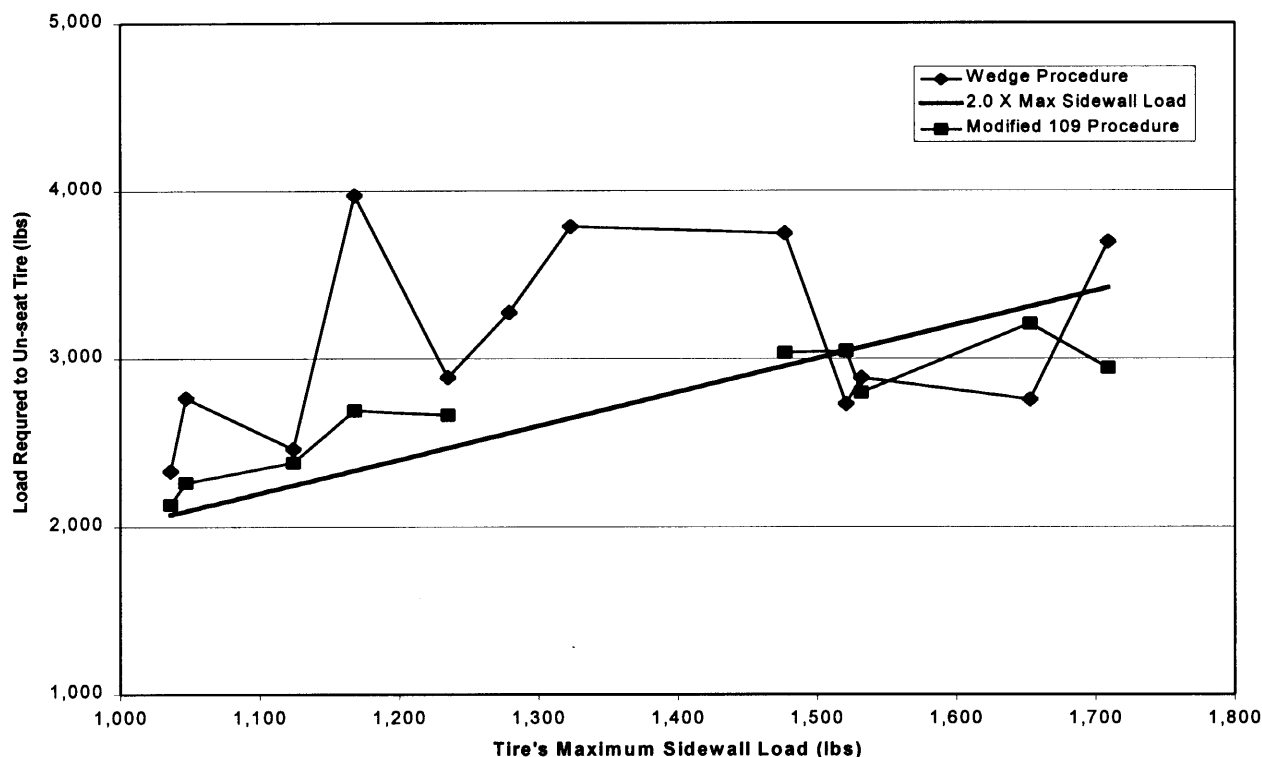
Figure 1: Comparison between Wedge and 109 Test Procedures
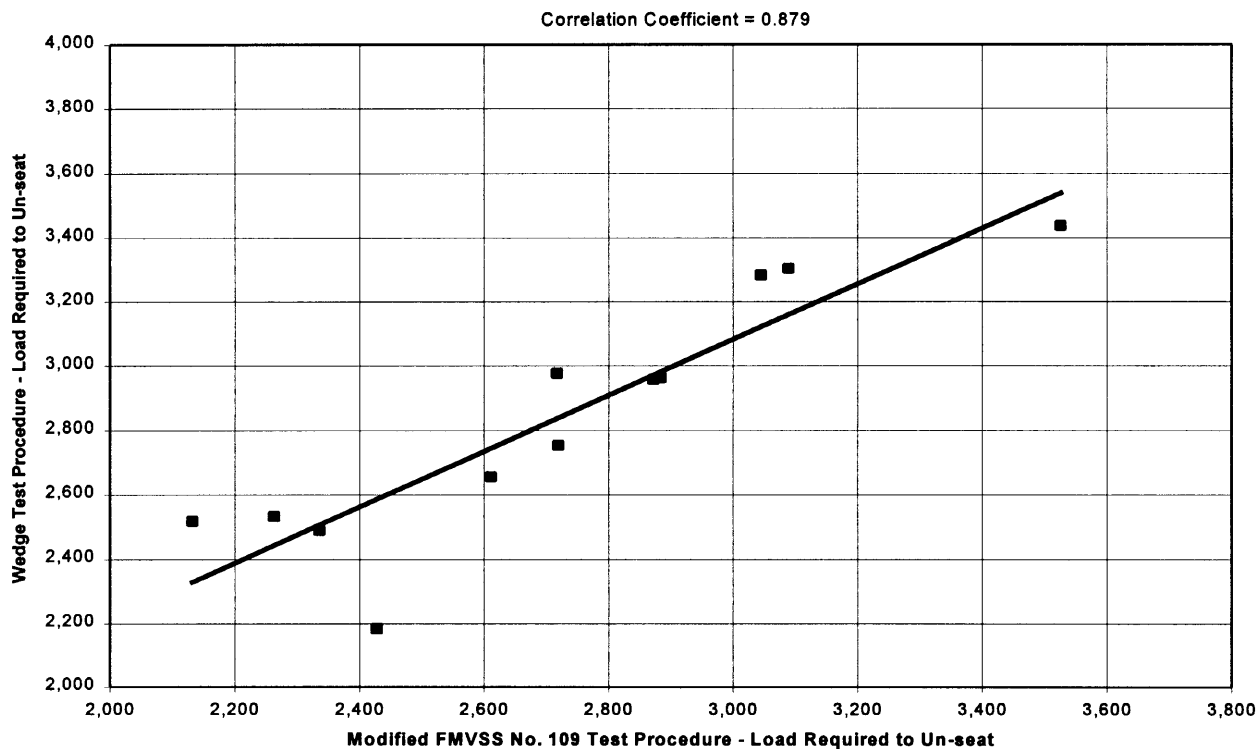
The data also show that there is a correlation between the load required to unseat a tire

for both the wedge-based procedure and the modified FMVSS No. 109 procedures vs. the sidewall load. This is shown in Figure 2.

Figure 2: Load Required to Un-seat Tire vs. Maximum Sidewall Load

Also shown in Figure 2 is a reference line depicting 2.0 times the tire's sidewall load i.e. maximum load. This line represents the level of force that might be expected during an extreme turning maneuver. The data points in Figure 2 are averages. A single data point was calculated by summing the load required to unseat the tire for all tires tested (across width, aspect ratio, etc.) with a particular load rating and then dividing by the number of tires tested with that load rating. Not every point consists of the same number of tires. This leads to some of the variation seen in the curve.

It is also important to note that, based on anecdotal evidence from vehicle testing at NHTSA's Vehicle Research and Test Center (VRTC), the dynamic mode for on-road tire

debeading is very different from the quasi-static loading conditions used in either the current FMVSS No. 109 or wedge-based testing. The dynamic mode of debeading, seen during the on-road vehicle maneuvers, is characterized by violently varying extreme loads being transferred to the tire undergoing debeading.

Additional testing will be conducted to investigate further the causes of, and potential compliance tests for, tire debeading.

APPENDIX 1

TOYOTA TEST PROCEDURE – DESCRIPTION, DRAWINGS, PHOTOS,

AIR LOSS BENCH TEST METHOD FOR TUBELESS TIRES

1. Scope

   This standard covers the air loss bench test method for tubeless tires, a method of evaluating tire performance.

2. Definitions

   (1) Air loss test

   A tire that receives a lateral force from the ground is deformed and may be deflated as its tire bead is separated from the rim bead. The air loss test is intended to measure the tire inflation pressure at which a tire is deflated under the above condition. The test may be conducted with an actual vehicle or with a tire assembly on a test bench.

   (2) On-vehicle air loss test method

   When an actual vehicle is used for the air loss test, the vehicle is driven at 60 km/h along a straight course, then makes a curve with a radius of 25 m so that a lateral force is applied to the test tire, as shown in Fig. 1. This so-called J turn test method is recommended because the fluctuation in input load is relatively small.

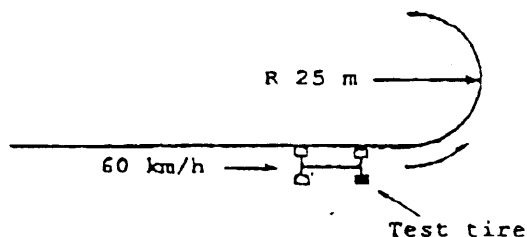R 25 m

60 km/h

Test tire

Fig. 1 Schematic of J Turn

3. Test Apparatus

   The outline of the air loss bench test apparatus is shown in Fig. 2, and that of the control panel in Fig. 3. The name of each part is shown in the figures. In addition to the components shown in Fig. 2, an essential component of the apparatus is a hydraulic pump (maximum pressure: 10 MPa, maximum discharge: 50 L/min).

Tire inclination angle
5°

Tire lifting/lowering (motor-driven)

Tire height indication

Tire height indication scale

Lateral load

Disk wheel mount

Tire mounting shaft

Test tire

Simulated road surface

Road surface inclination angle
10°

Slidable base block
(Stroke: 400 mm)

Hydraulic cylinder

Load cell for lateral force

Fig. 2 Outline of Test Apparatus

Digital load indicator

Buzzer switch

Up/down button (for tire)

Forward/stop/backward button (for base block)

Tire inflation pressure gage (bourdon tube type) 1 MPa (max.)

Tire inflation pressure control valve

Power switch
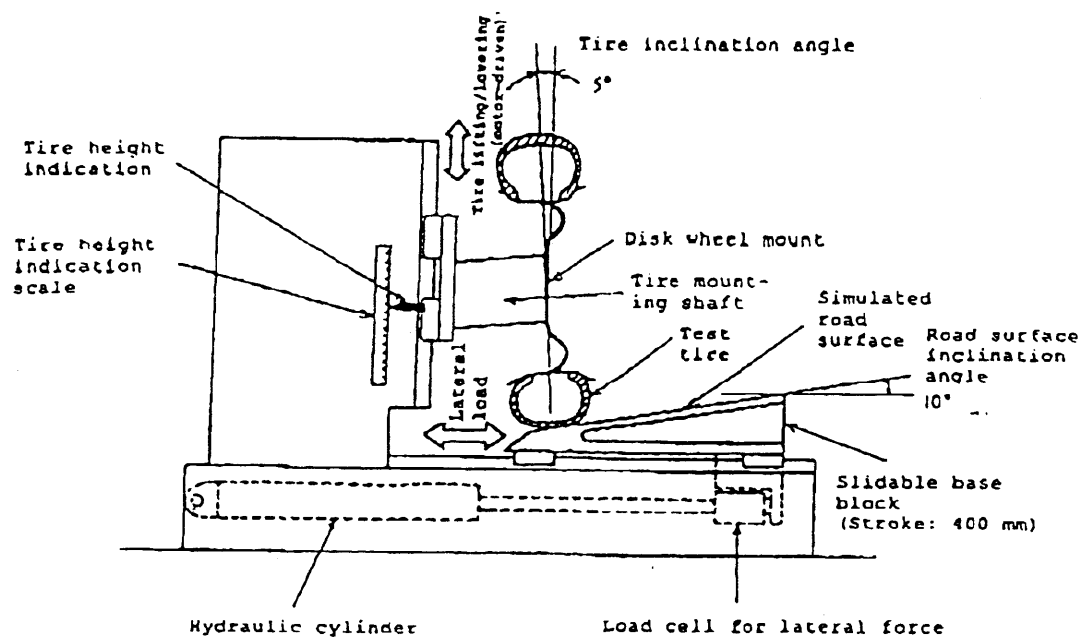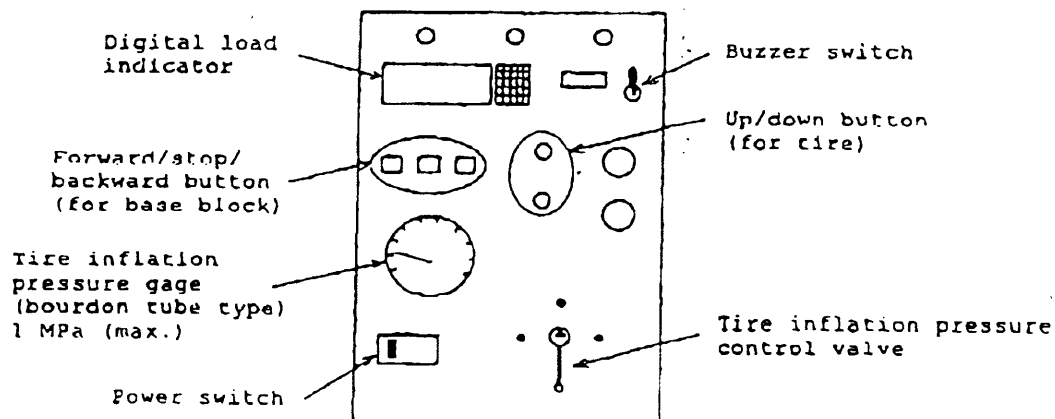
Fig. 3 Outline of Control Panel

4. Test Method

4.1 The Preparation

The following test specimens shall be prepared: Tire-wheel assembly: 2 sets (or tire and wheels separately)

4.2 Test Conditions

4.2.1 Tire Inclination Angle

The tire inclination angle shall be 5° to the vertical axis (see Fig. 2).

4.2.2 Simulated Road Surface Inclination Angle

The simulated road surface inclination angle shall be 10° to the horizontal axis (see Fig. 2). The road surface shall be free from rubber and other substances.

4.2.3 Base Block Speed

The base block shall be driven at 200 mm/s (adjusted under a no-load condition). The base block speed shall be controlled by the hydraulic pump discharge control valve.

4.2.4 Tire Mounting

No lubricant, such as soapy water, should be used when mounting the tire. The tire inflation pressure, after mounting, shall be set at 300 to 400 kPa. When the test is conducted consecutively on the same tire after an air loss or a rim touch occurs, the inflation pressure shall be raised to 300 to 400 kPa before being set at the specified value.

4.2.5 Lateral Force Setting

The lateral force for the test shall be set at three levels in steps of 2 kN. The tire inflation pressure under which an air loss or a rim touch occurs shall be measured at each level of lateral force. The lateral force levels should be such that the median setting is 1.98 times the front wheel load of the vehicle on which the tire is mounted. The load cell for lateral load measurement shall be calibrated regularly. The maximum allowable error is 2%.

4.3 Test Procedure

The test shall be conducted according to the following procedure:

4.3.1 Preparation of Test Specimen

Mount the tire and wheel if they are not preassembled. (Lubricants such as soapy water must not be used.) If the tire and wheel are already mounted, remove the tire bead, and wipe off any lubricant, such as soapy water, from the tire bead and rim bead with a dry cloth.

4.3.2 Preparation of Test Apparatus
(1) Turn on the power switch of the test apparatus.
(2) Turn on the hydraulic pump switch for warming up (30 minutes or longer).
(3) Set the load indication of the control panel to 0 under a no-load condition.

4.3.3 Testing
(1) Set the test tire on the test apparatus.
(2) Connect a tire inflation hose to the tire air valve.
(3) Set the inflation pressure to about 400 kPa.
(4) Adjust the vertical position of the tire such that the tire is in contact with the edge of the simulated road surface.
(5) Adjust the position of the tire height indication scale so that the tire height with respect to the road surface can be easily read.
(6) Drive the base block forward to apply a lateral force to the tire. While watching the load indication on the control panel, rotate the hydraulic valve slowly to adjust the load so that the base block stops balanced at the specified lateral force. Then, drive the base block backward and then forward again to confirm the lateral force. It is recommended that the test be conducted first with the largest lateral force, then with smaller ones.
(7) Adjust the tire inflation pressure under no load. A recommended initial inflation pressure is design inflation pressure + 50 kPa.
(8) Drive the base block forward to apply a lateral force, and maintain the lateral force for 20 seconds. The timer and buzzer may be used to signal the passage of 20 seconds.
(9) If an air loss or rim touch does not occur when the base block is forwarded to its full stroke position, drive it backward, lower the tire, and drive it forward to apply a lateral force again.
(10) When the base block stops in the middle, wait for 20 seconds. If an air loss or a rim touch does not occur in this 20 seconds, repeat the procedure from step (8), decreasing the inflation pressure (under no load) in steps of 10 kPa until an air loss occurs.
(11) When an air loss or a rim touch occurs, record the lateral force (load indication on the control panel), inflation pressure and vertical position of the tire.
(12) Restore the tire. Raise the inflation pressure first to 300 to 400 kPa then adjust it to 10 kPa plus the inflation pressure at which air loss or a rim touch has occurred. Repeat the procedure from step (8) to measure the inflation pressure at which an air loss or a rim touch occurs for the second time at the same lateral force level.
(13) Adjust the hydraulic pressure for the next level of lateral force in the procedure described in step (6), and repeat steps (7) through (12).

5. Reporting of Test Results
  (1) Data processing
    The test results shall be arranged in the form of graphs. Plot the inflation
    pressure at which an air loss or a rim touch has occurred on the vertical
    axis against the lateral force at which air loss or a rim touch occurs on
    the horizontal axis (see Fig. 4). For each plot, designate air pressure as
    air loss or rim touch air pressure.
  (2) Other items to be reported.
    (a) Test date
    (b) Test method
      State that the test was conducted according to this standard.
    (c) Information on test tire
      (i) Tire size
      (ii) Manufacturer
      (iii) Part No.
      (iv) Serial number (Identification number)
      (v) Rim size
      (vi) Part No. and other information on wheel
      (vii) Detail of test tire
    (d) Vehicle specifications
      Vehicle wheel load, design inflation pressure, tire load factor
    (e) Experimenter
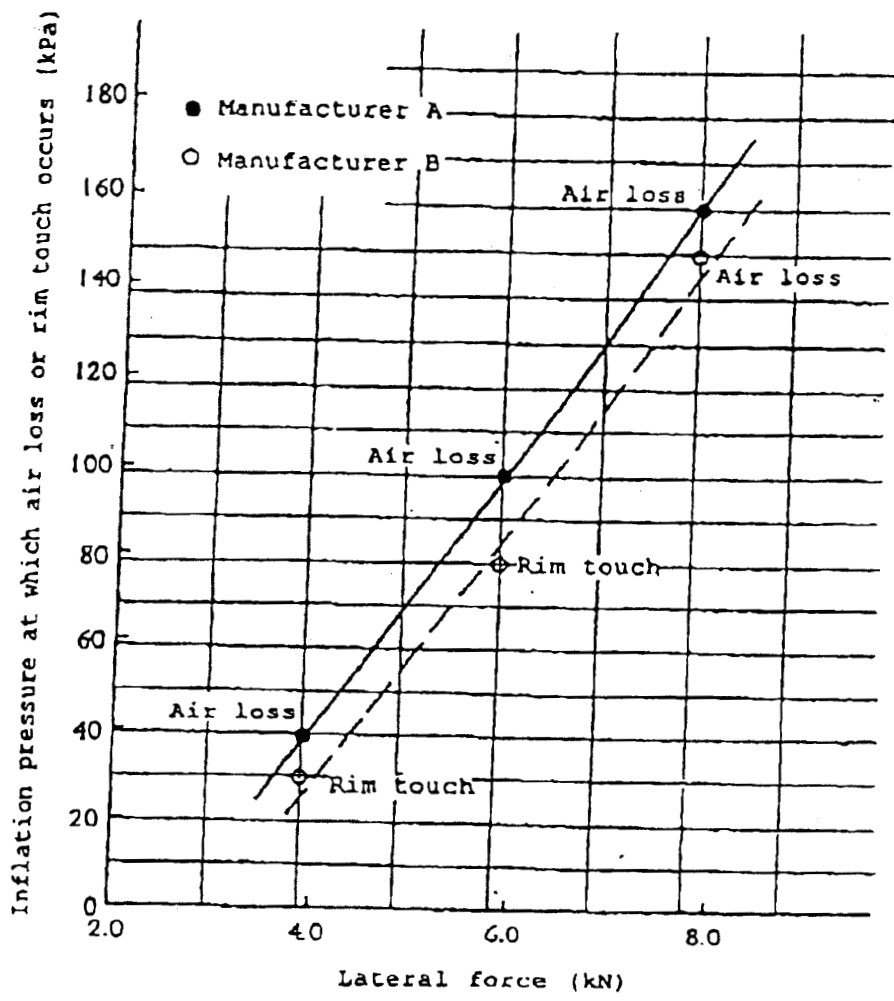   (f) Person requesting the test
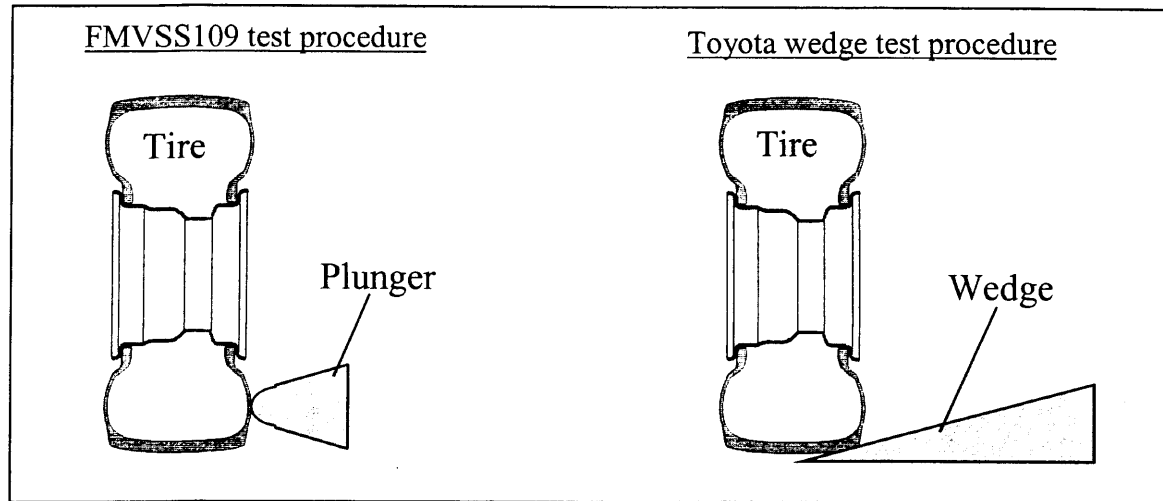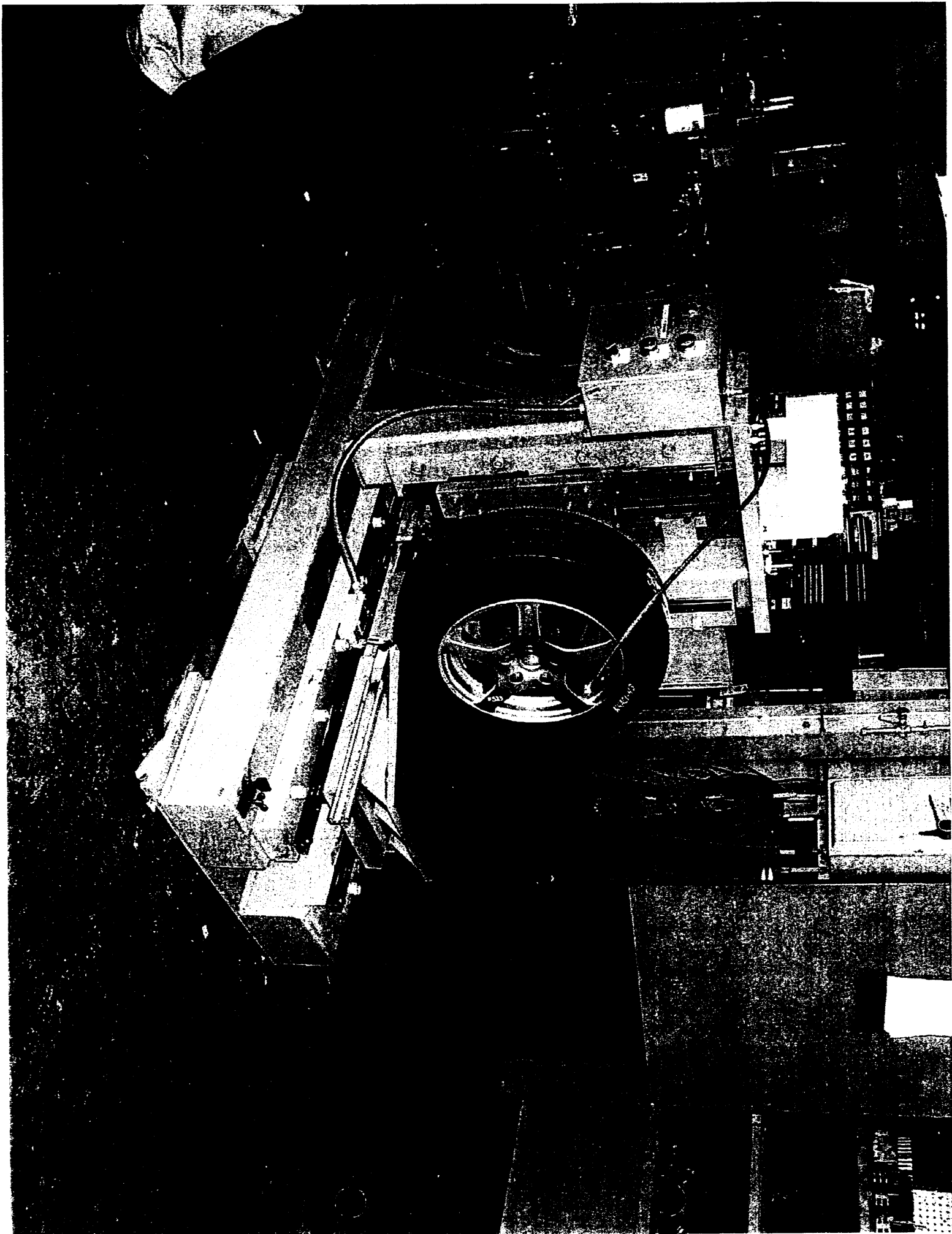
Fig. 4 Test Result Data in Graph Form (Example)

Figure1: The two in-lab tire bead unseat test procedures

APPENDIX 2

TEST MATRIX AND SUMMARY SHEETS

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Test Matrix
Dynamic Bead Unseat to Unseat Level

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Size	Brand	Tire Construct	Test #	SN	UTQG	LI	SI	Rim	PSI	Lube 4 hrs	24 hrs	48 hrs	1 week	109 BU	NOTES
P175/70R13	BFG Radial T/A 705	2P2S	NHAC1-01	BE0201	360AB	82	S	5.0						X	wedge
P175/70R13	Goodyear Aqua Tread 3	2P2S	NHAC1-02	MK0900	460AB	82	S	5.0							
P175/70R13	FirestoneFT70C	1P2S	NHAC1-03	HY1501	480AB	82	S	5.0							●
175/70R13	Dunlop SP20A/S	1P2S	NHAC1-04	JT479	400AB	82	S	4.5, 5.0, 6.0						X	wedge
175/70R13	Michelin Rain Force MX4	1P2S	NHAC1-05	HH1101	420AB	82	T	4.5, 5.0, 6.0							
P185/65R14	Goodyear Regatta II	1P2S	NHAC1-06	MK5100	560AB	85	T	5.5							
P185/65R14	BFG Control T/A M65	1P2S	NHAC1-07	BF2201	460AB	82	S	5.5							
P185/65R14	Michelin Rain Force	1P2S	NHAC1-08	HN2001	500AB	85	T	5.5						X	
P185/65R14	Dunlop SP20FE	1P2S	NHAC1-09	DB0601	320AB	85	T	5.5							
P205/60R14	BFG Touring T/A HR4	2P2S1N	NHAC1-10	BE2001	380AA	88	H	6.0							
P205/60R14	Dunlop D60AZ JLB	1P2S1N	NHAC1-11	DB3500	320AAA	88	H	6.0							●
P205/60R14	Goodyear Eagle HP	1P2S2N	NHAC1-12	MM489	380AA	88	H	6.0						X	
P205/60R14	Firestone Firehawk SH20	1P2S1N	NHAC1-13	W21901	460AA	88	H	5.5, 6.0, 7.0						X	5 tires
P205/60R14	Firestone Firehawk SH20	1P2S1N	NHAC1-14	W21901	460AA	88	H	6.0		X					
P205/60R14	Firestone Firehawk SH20	1P2S1N	NHAC1-15	W21901	460AA	88	H	6.0			X				
P205/60R14	Firestone Firehawk SH20	1P2S1N	NHAC1-16	W21901	460AA	88	H	6.0				X			
P205/60R14	Firestone Firehawk SH20	1P2S1N	NHAC1-17	W21901	460AA	88	H	6.0					X		
P205/75R14	BFG Control T/A M80	1P2S	NHAC1-18	BH4500	580AB	95	S	6.0							

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Size	Brand	Tire Construct	Test #	SN	UTQG	LI	SI	Rim	PSI	Lube 4 hrs	24 hrs	48 hrs	1 week	109 BU	NOTES
P205/75R14	Goodyear Regatta II	1P2S	NHAC1-19	M6010	560AB	95	S	6.0							
P205/75R14	Firestone FT70C	1P2S	NHAC1-20	EJ509	480AB	95	S	5.5, 6.0, 7.0						X	
P205/75R14	Michelin XH4	1P2S	NHAC1-21	HN109	580AB	95	S	5.0, 6.0, 7.0							●
P205/75R14	Dunlop SP 50/A/S	1P2S	NHAC1-22	TR2301	360AB	NO	NO	*5.5						X	5 tires
P205/75R14	Dunlop SP 50/A/S	1P2S	NHAC1-23	TR2301	360AB	NO	NO	6.0		X					
P205/75R14	Dunlop SP 50/A/S	1P2S	NHAC1-24	TR2301	360AB	NO	NO	6.0			X				
P205/75R14	Dunlop SP 50/A/S	1P2S	NHAC1-25	TR2301	360AB	NO	NO	6.0				X			
P205/75R14	Dunlop SP 50/A/S	1P2S	NHAC1-26	TR2301	360AB	NO	NO	6.0					X		
P215/65R16	General G4S	1P2S	NHAC1-27	A30401	520AB	96	S	6.5							
215/65R16	Goodyear Eagle LS	1P2S	NHAC1-28	MK038	360AB	98	S	6.5						X	
215/65R16	Pirelli P6000	1R2S2N	NHAC1-29	XT035	180AA	98	W	6.5						X	●
215/65R16	Michelin MX4	1P2S	NHAC1-30	M31601	420AB	98	S	6.5							
215/45ZR16	Dunlop SP Sport D8050	2R2S1PM	NHAC1-31	U2109	120AA	NO	NO	7.0							
215/45ZR16	Michelin Pilot Sport	2R2S1PM	NHAC1-32	FH0301	220AAA	86	Y	7.0						X	
215/50ZR16	BFG Comp T/A KDW	2P2S1N	NHAC1-33	BE0100	300AAA	90	Y	7.0							
P215/50R16	Firestone FirehawkGTA	1P2S	NHAC1-34	W22001	300AAA	89	V	7.0							
225/45ZR16	Goodyear Eagle F1 GS -02	1R2S1AR	NHAC1-35	ND4900	100AA	NO	NO	7.0							
P225/55ZR16	Firestone FirehawkSZ 50 EP	2P2S1N	NHAC1-36	EJ0900	344AAA	no	no	6.0, 7.0, 8.0						X	

* not available
Some rims may not be available; closest will be used within +/- 0.5"

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Size	Brand	Tire Construct	Test #	SN	UTQG	LI	SI	Rim	PSI	Lube 4 hrs	24 hrs	48 hrs	1 week	109 BU	NOTES
P225/55ZR16	Dunlop SP 9000	1P2S1N	NHAC1-37	EU409	280AAA	NO	NO	7.0							
225/55ZR16	Michelin Pilot HX (MXM)	2R2S1PM	NHAC1-38	HB2000	140AA	NO	NO	6.0, 7.0, 8.0						X	
225/55ZR16	BFG G Force T/A KDW	2P2S1N	NHAC1-39	BE269	300AAA	95	Y	7.0							●
225/55R16	Goodyear Eagle GT + 4	2P2S2N	NHAC1-40	M61801	240AA	94	V	7.0							5 tires
225/55R16	Goodyear Eagle GT + 4	2P2S2N	NHAC1-41	M61801	240AA	94	V	7.0			X				
225/55R16	Goodyear Eagle GT + 4	2P2S2N	NHAC1-42	M61801	240AA	94	V	7.0				X			
225/55R16	Goodyear Eagle GT + 4	2P2S2N	NHAC1-43	M61801	240AA	94	V	7.0					X		
225/55R16	Goodyear Eagle GT + 4	2P2S2N	NHAC1-44	M61801	240AA	94	V	7.0						X	
215/65R16	Firestone FT 70C	2P2S2P	NHAC1-45	EJ4400	480AB	98	T	6.0, 7.0, 8.0							
P275/40ZR18	Firestone FirehawkSZ 50 RFT	2S2R1N	NHAC1-46	EJ2001	340AAA	94	Y	9.0							
275/40R18	Dunlop SP 9000	1R2S2N	NHAC1-47	DM1400	280AA	99	Y	9.0							●
P275/40ZR18	Goodyear Eagle F1 G S	2P2S2N	NHAC1-48	M61701	300AAA	94	Y	9.0						X	
275/40ZR18	BFG G Force T/A KDW	2P2S2N	NHAC1-49	BD2800	300AAA	99	Y	9.0							
275/40ZR18	Michelin Pilot Sport (Z)	1R2S1PM	NHAC1-50	FH1601	220AAA	99	Y	9.0						X	
P185/65R14	FirestoneFT70C	1P2S1P	NHAC1-51	EM1901	480AB	85	S	5.5							
P205/60R14	Michelin Pilot XGT H4	1P2S	NHAC1-52	2X3500	400AA	88	H	5.5, 6.0, 7.5							
255/65R16	Dunlop Grand Trek TG35	2P2S1N	NSA1-344	DB0501	RF418	109	H	8.0						X	
255/65R16	Dunlop Grand Trek TG35	2P2S1N	NSA1-345	DB0501	LF421	109	H	8.0							

* not available
Some rims may not be available; closest will be used within +/- 0.5"

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Test Matrix
Dynamic Bead Unseat to Unseat Level

Size	Brand	Tire Construct	Test #	SN	UTQG	LI	SI	Rim	PSI	Lube 4 hrs	24 hrs	48 hrs	1 week	109 BU	NOTES
QUANTITY OF TESTS								60	13	3	3	3	3	15	

Tire SN
EJ=BR JAP
EU=SUM JAP
HB=MICH GER
B3=UG AL
M6=GY OK
DM=DUN GER
FH=MI FR
MK=GY TN

Tire SN
HY=B/F OK
HH=MI ITAL
HN=MI NS
DB=DUN AL
MM=GY NC
W2=B/F TN
PL=KS TX
A3=GEN IL

Tire SN
XT=PIR GER
M3=MI SC
U2=SUMI JAP
ND=GY GER
LT=UNIR TRKY

* not available
Some rims may not be available; closest will be used within +/- 0.5"

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Size	Brand	Test #	Rim	Wedge BU lbs.	WBU/max Load	PSI/ Load	109 BU	Comments
P275/40ZR18	Firestone FirehawkSZ 50 RFT	NHAC1-46	9	4913	3.32	44/1477		Did not unseat - hit rim
275/40R18	Dunlop SP 9000	NHAC1-47	9	3993	2.34	51/1709		VHS Video
P275/40ZR18	Goodyear Eagle F1 G S	NHAC1-48	9	3623	2.45	44/1477	2979	Did not unseat,1st or 2nd run; 4818 2nd run
275/40ZR18	BFG G Force T/A KDW	NHAC1-49	9	3489	2.04	44/1709		Did not unseat; 1st or 2nd run; 4970 2nd run
275/40ZR18	Michelin Pilot Sport (Z)	NHAC1-50	9	3899	2.28	51/1709	2942	Did not unseat - hit rim
P225/55ZR16	Firestone FirehawkSZ 50 EP	NHAC1-36	6	3284	2.22	44/1477		
P225/55ZR16	Firestone FirehawkSZ 50 EP	NHAC1-36	7	3304	2.24	44/1477	3089	
P225/55ZR16	Firestone FirehawkSZ 50 EP	NHAC1-36	8	3647	2.48	44/1477		wedge video
P225/55ZR16	Dunlop SP 9000	NHAC1-37	7	3808	2.58	51/1477		
225/55ZR16	Michelin Pilot HX (MXM)	NHAC1-38	6	2535	1.66	51/1521		Did not unseat
225/55ZR16	Michelin Pilot HX (MXM)	NHAC1-38	7	3284	2.16	51/1521	3045	
225/55ZR16	Michelin Pilot HX (MXM)	NHAC1-38	8	2925	1.92	51/1521		2nd test 3087 lbs.
225/55ZR16	BFG G Force T/A KDW	NHAC1-39	7	4278	2.81	44/1521		
225/55R16	Goodyear Eagle GT + 4	NHAC1-40	7	3258	2.20	44/1477		*Missing graph/data*
P215/65R16	General G4S	NHAC1-27	6.5	2687	1.72	44/1565		
215/65R16	Goodyear Eagle LS	NHAC1-28	6.5	2963	1.79	44/1653	2884	
215/65R16	Pirelli P6000	NHAC1-29	6.5	3437	2.08	44/1653	3526	
215/65R16	Michelin MX4	NHAC1-30	6.5	3113	1.88	44/1653		

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Size	Brand	Test #	Rim	Wedge BU lbs.	WBU/max Load	PSI/ Load	109 BU	Comments
215/65R16	Firestone FT 70C	NHAC1-45	6	2636	1.60	44/1653		2nd test 2483 lbs.
215/65R16	Firestone FT 70C	NHAC1-45	7	2877	1.74	44/1653		
215/65R16	Firestone FT 70C	NHAC1-45	8	3178	1.92	44/1653		Revised 8/2
215/45ZR16	Dunlop SP Sport D8050	NHAC1-31	7	4270	3.66	44/1168		
215/45ZR16	Michelin Pilot Sport	NHAC1-32	7	3675	3.14	51/1168	2692	3238 2nd did not unseat Did not unseat
215/50ZR16	BFG Comp T/A KDW	NHAC1-33	7	3784	2.86	44/1323		4689 2nd, did not unseat Did not unseat
P215/50R16	Firestone FirehawkGTA	NHAC1-34	7	2716	2.12	44/1279		
225/45ZR16	Goodyear Eagle F1 GS -02	NHAC1-35	7	3830	3.00	44/1279		
P205/75R14	BFG Control T/A M80	NHAC1-18	6	2945	1.92	35/1532		Odd force curve
P205/75R14	Goodyear Regatta II	NHAC1-19	6	2866	1.87	44/1532		
P205/75R14	Firestone FT70C	NHAC1-20	5.5	2754	1.80	44/1532	2719	Goodyear Correlation @ 13.3 psi 1460 lbs. ; *Missing graph/data*
P205/75R14	Firestone FT70C	NHAC1-20	6	2957	1.93	44/1532		
P205/75R14	Firestone FT70C	NHAC1-20	7	2742	1.79	44/1532		Odd force curve
P205/75R14	Michelin XH4	NHAC1-21	5	3150	2.06	35/1532		Did not unseat
P205/75R14	Michelin XH4	NHAC1-21	6	2822	1.84	35/1532		
P205/75R14	Michelin XH4	NHAC1-21	7	2670	1.74	35/1532		Odd force curve
P205/75R14	Dunlop SP 50/A/S	NHAC1-22	6	2957	1.93	35/1532	2872	
P205/60R14	BFG Touring T/A HR4	NHAC1-10	6	2945	2.38	44/1235		

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Size	Brand	Test #	Rim	Wedge BU lbs.	WBU/max Load	PSI/ Load	109 BU	Comments
P205/60R14	Dunlop D60AZ JLB	NHAC1-11	6	2931	2.37	35/1235		
P205/60R14	Goodyear Eagle HP	NHAC1-12	6	2656	2.15	44/1235	2611	
P205/60R14	Firestone Firehawk SH20	NHAC1-13	5.5	2420	1.96	44/1235		Odd force curve
P205/60R14	Firestone Firehawk SH20	NHAC1-13	6	2977	2.41	44/1235	2717	
P205/60R14	Firestone Firehawk SH20	NHAC1-13	7	3167	2.56	44/1235		
P205/60R14	Michelin Pilot XGT H4	NHAC1-52	5.5	3479	2.82	44/1235		
P205/60R14	Michelin Pilot XGT H4	NHAC1-52	6	3320	2.69	44/1235		
P205/60R14	Michelin Pilot XGT H4	NHAC1-52	7.5	3256	2.64	44/1235		
P185/65R14	Goodyear Regatta II	NHAC1-06	5.5	2647	2.36	44/1124		
P185/65R14	BFG Control T/A M65	NHAC1-07	5.5	2204	1.96	35/1124		Odd force curve
P185/65R14	Michelin Rain Force	NHAC1-08	5.5	2489	2.21	35/1124	2336	Odd force curve
P185/65R14	Dunlop SP20FE	NHAC1-09	5.5	2515	2.24	51/1124		Odd force curve
P185/65R14	FirestoneFT70C	NHAC1-51	5.5	2184	1.94	44/1124	2428	
P175/70R13	BFG Radial T/A 705	NHAC1-01	5	2517	2.43	35/1036	2132	
P175/70R13	Goodyear Aqua Tread 3	NHAC1-02	5	2489	2.40	44/1036		
P175/70R13	FirestoneFT70C	NHAC1-03	5	1987	1.92	44/1036		
175/70R13	Dunlop SP20A/S	NHAC1-04	4.5	2533	2.42	35/1047	2263	
175/70R13	Dunlop SP20A/S	NHAC1-04	5	2292	2.19	35/1047		

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Size	Brand	Test #	Rim	Wedge BU lbs.	WBU/max Load	PSI/ Load	109 BU	Comments
175/70R13	Dunlop SP20A/S	NHAC1-04	6·	2314	2:21	35/1047		
175/70R13	Michelin Rain Force MX4	NHAC1-05	4.5	2995	2.86	35/1047		
175/70R13	Michelin Rain Force MX4	NHAC1-05	5	2230	2.13	35/1047		
175/70R13	Michelin Rain Force MX4	NHAC1-05	6	2555	2.44	35/1047		
255/65R16	Dunlop Grand Trek TG35	NSA1-344	8	4348	1.92	44/2271	3714	32psi Special Tire/Rim for VRTC
255/65R16	Dunlop Grand Trek TG35	NSA1-345	8	4456	1.96	44/2271		32psi Special Tire/Rim for VRTC
QUANTITY OF TESTS				60			16	